3rd Year

Common Courses

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1. 55000022 Metallic Materials Science I
2. 55000024 Fluid Mechanics I
3. 55000025 Electronics Fundamentals
4. 55000026 Control Fundamentals
5. 55000027 Strength of Material
6. 55000028 Productive Systems Organization
7. 55000030 Heat Transfer
8. 55000031 Structure and Properties of Non-Metallic Materials
9. 55000032 Theory of Machines and Mechanisms
10. 55000033 Manufacturing
11. 55000034 Fluid Mechanics II
12. 55000035 Advanced Strength of Materials

55000025 - ELECTRONICS FUNDAMENTALS

CREDITS:	4.5 ECTS
DEPARTMENT:	Automatic Control, Electrical and Electronics Engineering and Industrial Informatics (AUT)
COURSE COORDINATOR:	Jorge Portilla/Miroslav Vasić
TYPE:	Mandatory
YEAR AND SEMESTER:	3rd Year / Fall

LIST OF TOPICS

MODULE 1. Fundamentals of Digital Electronics

- 1) Boole Algebra, Logic Gates
- 2)Combinational circuits
- 3) Sequential circuits. Flip-flops. Typical sequential circuits. Diagram of States, Analysis of secuential circuiy¡ts

MODULE 2. Fundamentals of microprocessors

- 4) Microprocessors and microcontrollers
- 5) Minimum microprocessor system. Buses, memory and I/O
- 6) Basic internal architecture. Basic execution cycle
- 7) Registers and addressing modes
- 8) Assembly language. Set of instructions. Examples

MODULE 3. Fundamentals of analog electronics

- 9) Electronic devices. Diode, Zener diodes and transistors.
- 10) Applications: rectification and regulation. Amplification with transistors
- 11) Ideal operational amplifier. Linear and non-linear applications
- 12) Amplification

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE: Electrical engineering

TOPIC: Circuit Theory

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Ability to interpret the operation of electrical circuits
- Management of the foundations of logic and binary numbering systems
- Ability of reasoning on how to perform a program, their data types and algorithms.

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Implementation of a digital circuit in a FPGA, experimentally validating its operation
- Ability to understand the fundamentals of a microprocessor system
- Ability to analyze simple digital circuits consisting of bistable and logic gates, and interpret their performance using state diagrams.
- Programming a microprocessor simple, experimentally validating its operation
- Ability to understand the characteristics of analog circuits and resolve simple analytic form circuits, in the domain of time and frequency
- Analysis and validation of the performance of analog circuits using simulation tools.

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_2. An ability to apply engineering design to produce solutions that meet specified needs with consideration fo public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- ABET_3. An ability to communicate effectively with a range of audiences
- ABET_5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- ABET_6. An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions

BIBLIOGRAPHY

TEXT BOOKS

- **Microcontrollers and microcomputers : principles of software and hardware engineering**
  Cady, Frederick M.
- **Digital Design and Computer Architecture**.
  David Money and Sarah Harris. Elsevier-Morgan Kauffmann
- **Electronics: A Systems Approach, 6th Edition**
  Dr Neil Storey, Formerly at University of Warwick, 2017, Pearson, Available

OTHER MATERIALS

- **Slides prepared by professors**

55000026 - CONTROL FUNDAMENTALS

CREDITS:	3 ECTS
DEPARTMENT:	Automatic Control, Electrical and Electronics Engineering and Industrial Informatics (AUT)
COURSE COORDINATOR:	Ernesto Gambao
TYPE:	Common
YEAR AND SEMESTER:	3rd Year / Fall

LIST OF TOPICS

MODULE 1. Design of control systems

- 1) Steady-state errors
- 2) Root Locus
- 4) PID control
- 5) Adjustment of PID

MODULE 2. Automation systems

- 6) Introduction to automation systems
- 7) Discrete event systems
- 8) Discrete event modeling
- 9) Programmable logic controllers (PLC)
- 10) Introduction to PLC programming

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE: Systems Dynamics

TOPIC: Open loop continuous-time system modelling and analysis

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Basic skill of MATLAB
- Ability to develop basic mathematical calculations
- Ability to understand the model in differential equation of a physical system
- Ability to understand and manage the model on the basis of transfer of a physical system
- Capacity of critical interpretation of results

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Ability to design simple control algorithm
- Skill in the use of MATLAB control Toolbox
- Ability to address the logical control, both in the manufacturing automation and in the process industry

STUDENT OUTCOMES

• ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

• ABET_6. An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions

BIBLIOGRAPHY

TEXT BOOKS

Teoría de Sistemas
F. Matía, A. Jiménez, R. Aracil, E. Pinto Editorial Sección Publicaciones ETSIIM, 2006-4ª Edición

Fundamentos de Control con Matlab
E. Pinto y F. Matía Editorial Pearson, 2010

Sistema de Producción Automatizados
A. Barrientos y E. Gambao. Editorial Sección Publicaciones ETSIIM, 2014-2ª Edición

Autómatas programables y Sistemas de Automatización
E. Mandado y otros Editorial Marcombo, 2ª Edición

Autómatas Programables
J. Balcells, J.L. Romeral Editorial Marcombo-Boixareu

Ingeniería de Control Moderna
K. Ogata Editorial Prentice Hall, 4ª edición

OTHER MATERIALS

All the information about this subject including additional material and exams and is available at the Moodle site.

55000027 - STRENGTH OF MATERIALS

CREDITS:	4.5 ECTS
DEPARTMENT:	Mechanical Engineering (MEC)
COURSE COORDINATOR:	Rafael Claramunt
TYPE:	Common
YEAR AND SEMESTER:	3rd Year / Fall

LIST OF TOPICS

MODULE 1. Introduction

- 1) Description of the model of deformable solid
- 2) Description of the model of prismatic solid
- 3) Bearing conditions
- 4) Internal forces and moments and their diagrams. Link conditions
- 5) Static indeterminacy

MODULE 2. Stress and strain. Elastic behavior

- 6) Concept of stress. Normal and shear components
- 7) Concept of strain
- 8) Stress- strain relationship. Elastic behavior
- 9) Elastic energy. Energy theorems

MODULE 3. Tension/compression

- 10) Tension/compression of rods. Variable axial internal force. Statically indeterminate cases

MODULE 4. Torsion of circular rods

- 11) Elementary torsion theory

MODULE 5. Bending of beams

- 12) S ymmetric pure bending. Navier's law
- 13) The elastic curve. The singularity functions method
- 14) The unit load method
- 15) Statically indeterminate beams
- 16) Unsymmetric bending

MODULE 6. Buckling

- 17) Instability
- 18) Slenderness. Euler formula
- 19) Real buckling load. Buckling safety coefficient

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC: The Riemann multiple integral. (55000021-Extended calculus)

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- To identify the forces acting on a body and to know how to analyze its equilibrium
- Spatial vision
- Consider the logical development of a mechanical problem with rigor

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Modeling of solids as prismatic solids
- Analyze the behavior of a prismatic solid and its ability to withstand loads
- Learn the basic experimental techniques of mechanical testing

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_3. An ability to communicate effectively with a range of audiences
- ABET_6. An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions

BIBLIOGRAPHY

TEXT BOOKS

Resistencia de Materiales
Ortiz Berrocal Editorial McGraw-Hill

Mecánica de estructuras: Libro 1: Resistencia de Materiales
Cervera Editorial Edicions UPC

Problemas de Elasticidad y Resistencia de Materiales
Rodríguez-Avial, Zubizarreta, Anza Editorial Sección de publicaciones ETSII

Problemas de Resistencia de Materiales
Miroliúbov Editorial MIR

OTHER MATERIALS

WEB: http://rm.etsii.upm.es

55000028 - PRODUCTIVE SYSTEMS ORGANIZATION

CREDITS:	4.5 ECTS
DEPARTMENT:	Organization Engineering, Business Admnistration and Statistics(MAS)
COURSE COORDINATOR:	Maria Cristina De Stefano
TYPE:	Common
YEAR AND SEMESTER:	3rd Year / Fall

LIST OF TOPICS

MODULE 1. Introduction to linear programming

MODULE 2. Analysis of production system and its impact on the natural environment.

MODULE 3. Linear programming methods and graphics method

MODULE 4. Integer and mix linear programming models

MODULE 5. Human Resources Management

MODULE 6. Quality management

MODULE 7. Sustainable development

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Oral and written communication skills
- Understanding of English texts

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- • Systemic vision
- • Structuring in organizations decision problems
- • Elements for the decision making in organizations.

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
- ABET_5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and

inclusive environment, establish goals, plan tasks, and meet objectives

BIBLIOGRAPHY

TEXT BOOKS

Introducción a la Investigación de Operaciones
FS Hillier, GJ Lieberman Editorial McGrawHill, Novena edición (2010)

Investigación de Operaciones
Hamdy A. Taha Editorial Rama

Introducción a la Investigación de Operaciones
Frederick S. Hillier y Gerald J. Lieberman Editorial Mc Graw Hill, 2010 - novena edición

Dirección de la producción y de operaciones. Decisiones estratégicas.
Heizer, J. & Render, B., Prentice Hall, 2016.

Operations Management: Sustainability and Supply Chain Management,
Heizer, J., Render, B., C. Munson, Pearson 2016

OTHER MATERIALS

55000030 - HEAT TRANSFER

CREDITS:	4.5 ECTS
DEPARTMENT:	Energy Engineering (ENE)
COURSE COORDINATOR:	Javier Muñoz Antón
TYPE:	Common
YEAR AND SEMESTER:	3rd Year / Fall

LIST OF TOPICS

MODULE 1. Fundamentals

- 1) Heat transfer modes
- 2) Introduction to combined heat transfer

MODULE 2. Thermal properties of matter

- 3) Thermophysical properties

MODULE 3. Conduction

- 4) The conduction rate equation
- 5) Steady state conduction
- 6) Conduction with thermal energy generation
- 7) Heat transfer from extended surfaces
- 8) Transient conduction
- 9) Finite-difference methods.

MODULE 4. Convection

- 10) Forced convection
- 11) Free convection
- 12) Condensation
- 13) Boiling

MODULE 5. Heat exchangers

- 14) Heat exchanger analysis: NTU/LMTD methods.

MODULE 6. Radiation

- 15) Fundamental concepts for radiation.
- 16) View factors
- 17) Enclosure analysis

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE: Thermodynamics, Advanced maths

TOPIC: thermodynamic laws, advanced calculus, differential equations

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Advanced mathematics: differential equations
  THermodynamics: thermodynamic laws

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Acquire learning skills allowing for a continuous technological update during his future professional career.
- Incorporate new technologies and tools of Industrial Engineering in their professional activities
- Understand and apply fundamental knowledge of science and technology to the practice of mechanical engineering
- Ability to communicate knowledge and findings, both orally as written, to a specialised and non-specialised audience in a clear, unambiguous way.

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_3. An ability to communicate effectively with a range of audiences

BIBLIOGRAPHY

TEXT BOOKS

OTHER MATERIALS

- Incropera, De Witt, "Fundamentals of Heat Tranfer", 6th edition, Wiley, 2006. (libro oficial de la asignatura)
- Incropera, Dewitt, "Heat Transfer Fundamentals" (4th Ed), Pearson, Prentice Hall, México, 1999.
- A.J. Chapman, "Heat Transfer" (3rd Ed), Bellisco, Madrid, 1990
- J.P. Holman, "Heat Transfer", (8th Ed), McGraw-Hill, Madrid, 1998.
- J.H. Lienhard, "A heat transfer textbook", MIT (http://web.mit.edu/lienhard/www/ahtt.html)

55000031 - Structure and Properties of non-metallic materials

CREDITS:	4.5 ECTS
DEPARTMENT:	Chemical and Environmental Engineering (CHE)
COURSE COORDINATOR:	Katerina Foteinopoulou
TYPE:	Common
YEAR AND SEMESTER:	3rd Year / Spring

LIST OF TOPICS

MODULE 1. Methods / Background

- 1) Introduction
- 2) Structure and symmetry elements of materials- Point groups
- 3) Tensors and physical properties
- 4) Morphologies and structures
- 5) Conservation equations

MODULE 2. Applications – Physical properties of anisotropic materials

- 6) Properties of equilibrium
- 7) Properties of non-equilibrium
- 8) Homogenization of composite materials

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Spatial vision for identifying symmetry elements to classify crystalline structures to appropriate crystallographic class
- General physics (static and dynamics, electromagnetism)
- Calculate linear, surface and volumetric densities
- General chemistry, adjustment reactions and stoichiometric calculations
- Matrix algebra (operations with vectors and matrices, diagonalization, determinants)

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Design and advanced applications of non-metallic materials
- Rational design of new materials

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

BIBLIOGRAPHY

TEXT BOOKS

- Textbook in Spanish printed by the school: N. Jimeno, M. Laso in 'Estructura y Propiedades de Materiales no Metálicos' Escuela Técnica Superior de Ingenieros Industriales, Universidad Politécnica de Madrid.

OTHER MATERIALS

* A large collection (more than 250) of problems (separates in two volumes) with solutions; this collection includes past years´exams as well as extended problems inspired by contemporary applications of anisotropic materials.
* A Handbook that includes all necessary formulas (i.e. constitutive laws), tables, data and crystallographic stereograms.

The students are allowed to consult this handbook, which is actually the only material allowed to have aside, during the midterm and final exams.

55000032 - THEORY OF MACHINES AN MECHANISMS

CREDITS:	4,5 ECTS
DEPARTMENT:	Mechanical Engineering (MEC)
COURSE COORDINATOR:	José Luis Muñoz Sanz
TYPE:	Common
YEAR AND SEMESTER:	3rd Year / Spring

LIST OF TOPICS

MODULE 1. Basic concepts of machines and mechanisms

- 1) Elementary mechanisms
- 2) Passive resistance
- 3) Lubrication
- 4) Friction
- 5) Wear

MODULE 2. Basic pairs of use in machines

- 6) Friction bearings
- 7) Bearing
- 8) Other lower pairs

MODULE 3. Kinematics and dynamics of mechanisms

- 9) Kinematic study
- 10) Dynamic study - flywheels
- 11) Complete a simple case study
- 12) Synthesis of mechanisms
- 13) Spatial mechanisms

MODULE 4. Fundamentals of mechanical transmissions

- 14) Camshaft and camshaft
- 15) Transmission - sprockets
- 16) Ordinary trains
- 17) Trains epicyclic gears
- 18) Transmissions
- 19) Deformable bodies

MODULE 5. Vibrations in machines

- 20) Vibrations with a degree of freedom
- 21) Vibrations with two degrees of freedom

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Static and dynamic knowledge management
- Mechanical spatial sense and interpretation of drawings

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Use the specific tools available for kinematic analysis with ease and dynamic of each element.
- Projecting machines complexity medium through the integration of the different elements studied.
- Understand the process of complete development of a machine.
- Distinguish the elements most commonly used in the construction of machines.
  - Analyze the particular problems and how to address the design of each element, as well as external factors with influence on the behavior of each.
  - Be considered during the design interactions in operation between the various elements of machines, and their influence on the individual calculation.
- Decide between alternatives, most suitable for the design in each particular situation.
- Assess the adequacy of the design of a machine of media from the point of view cinematic complexity and dynamic.
- Promote the spirit of teamwork.

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_6. An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions

BIBLIOGRAPHY

TEXT BOOKS

- ***CINEMÁTICA Y DINÁMICA DE MÁQUINAS***.
  Adelardo de LAMADRID, Antonio de CORRAL.
  Sección de Publicaciones de la E.T.S.I.I.M.

- ***PRINCIPLES OF TRIBOLOGY***.
  J. HALLING.
  The MacMillan Press LTD.

- ***PROBLEMAS DE MECANISMOS*.**

  E. Bautista, J. L. Muñoz, J. Echávarri

  Sección de publicaciones de la E.T.S.I.I.M

OTHER MATERIALS

Several machines to be analyzed (assembled and disassembled). Machine design software EDIMPO and manuals for the practical sessions.

Kinematic simulation programs

55000033 - MANUFACTURING

CREDITS:	4.5 ECTS
DEPARTMENT:	Mechanical Engineering (MEC)
COURSE COORDINATOR:	Antonio Vizán
TYPE:	Common
YEAR AND SEMESTER:	3rd Year / Spring

LIST OF TOPICS

1. Manufacturing systems
2. Geometric specifications. Measurement and inspection
3. Classification of processes
4. Machining processes. Geometry
5. Machining processes. Wear and tool materials
6. Turning process
7. Machining economy
8. Hole machining process
9. Milling process
10. Process planning
11. Manufacture of Polymeric Components
12. Stretching and Extrusion
13. Lamination and Forge
14. Aditive manufacturing and other non-mechanical forming processes

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- It would be desirable that the student has basic knowledge in: Industrial design, mechanics, materials science, strength of materials, organization of productive systems; such as interpretation of drawings, materials, machines, organization and information technology.

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Designing manufacturing processes
- Select tools and design tools
- Define, analyze and optimize processes and tasks
- Use computer tools in manufacturing
- Design products from the perspective of its manufacture

- Select types of manufacturing depending on the product

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

BIBLIOGRAPHY

TEXT BOOKS

OTHER MATERIALS

https://moodle.upm.es/titulaciones/oficiales/login/login.php
http://aulaweb.etsii.upm.es

55000034 - FLUID MECHANICS II

CREDITS:	3 ECTS
DEPARTMENT:	Energy Engineering (ENE)
COURSE COORDINATOR:	Javier García
TYPE:	Common
YEAR AND SEMESTER:	3rd Year / Spring

LIST OF TOPICS

MODULE 1. Dimensional analysis and similarity

- 1) Pi theorem
- 2) Applications and examples
- 3) Interpretation of non-dimensional numbers
- 4) Partial similarity

MODULE 2. Unidirectional laminar liquid movements

- 5) Initial and boundary conditions
- 6) Simplification of the equations of motion
- 7) Non-permanent movements, Stokes flow, impulsive motion of a plate in a semi-infinite medium
- 8) Stationary movements, Couette flow and Hagen-Poiseuille flow, movement in tubes of circular cross-section, generalization to other sections
- 9) Laminar effect of finite length of the tube, the current stability and steadiness of the movement
- 10) Movements in ducts of slowly variable section and with small curvature. Estimation of local losses.
- 11) Introduction to the theory of lubrication.

MODULE 3. Ideal fluids

- 12) Simplifications of the momentum and energy equations.
- 13) Euler equations
- 14) Introduction to the concept of boundary layer
- 15) Initial and boundary conditions
- 16) Bernoulli equation
- 17) Stagnation properties

MODULE 4. Ideal fluids

- 18) Application to ducts, equations.
- 19) Stationary case, examples.
- 20) Unsteady case, examples, opening and closing of valves.

MODULE 5. Stationary motion of ideal gases in tubes

- 21) Form of variation of the fluid quantities.
- 22) Mach number. Subsonic and supersonic flow.
- 23) Influence of variation of the area. Examples.
- 24) Discharge through divergent-convergent nozzle (Laval). Choking.
- 25) Convergent nozzle

MODULE 6. Shockwaves.

- 26) Conservation equations through a discontinuity.
- 27) Normal and tangential discontinuities.
- 28) Normal shock wave. Variation of properties through it.
- 29) Notions of oblique shock wave.
- 30) Examples, download by divergent nozzle.

MODULE 7. Waves of small intensity

- 31) Jump through them.
- 32) transmission speed
- 33) Waves of compression and expansion.
- 34) Deformation of the wall, water hammer.

MODULE 8. Introduction to turbulence

- 35) Turbulent flows.
- 36) Average amounts
- 37) Description of the turbulent transport phenomena.

MODULE 9. Unidirectional turbulent flows

- 38) Unidirectional motion equations. Head loss
- 39) Moody diagram, effect of roughness and Reynolds number, correlations.
- 40) Tube of non-circular cross-section

MODULE 10. Movement of liquids in variable-section conduits

- 41) Equations of conservation of mass and momentum
- 42) Steady flows
- 43) Loss of pressure and total height. Kinetic energy of the output stream. Local losses. Equivalent length.
- 44) Piping connected with pump or turbine. Characteristic curve and point of operation.
- 45) In series, parallel and branching pipes.

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE: FLUID MECHANICS I

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

CALCULUS AND THERMODYNAMICS

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_6. An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions

BIBLIOGRAPHY

TEXT BOOKS

Mecánica de Fluidos
Antonio Crespo Martínez Editorial Thomson

OTHER MATERIALS

Problemas de Mecánica de Fluidos II. Sección de Publicaciones de la ETSII.

55000035 - ADVANCED STRENGTH OF MATERIALS

CREDITS:	3 ECTS
DEPARTMENT:	Mechanical Engineering (MEC)
COURSE COORDINATOR:	Rafael Claramunt
TYPE:	Common
YEAR AND SEMESTER:	3rd Year / Spring

LIST OF TOPICS

MODULE 1. Extension of Elasticity

- 1) The stress matrix. Principal stresses
- 2) Mohr circles
- 3) Elastic Energy
- 4) Failure criteria

MODULE 2. Torsion

- 5) Torsion of thin-walled members

MODULE 3. General bending

- 6) Shear stresses due to bending. Collignon formula. Thin-walled members
- 7) Bending of composite beams

MODULE 4. Member joints and plate girders

- 8) Design of bolted joints
- 9) Design of welded joints
- 10) Plate girders

MODULE 5. Combined loads

- 11) Bending and tension/compression
- 12) Bending and torsion
- 13) General case of loading. Application: Helical springs

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC: Statics (1011-physics General I)

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Be able to find the internal forces, stresses and strains in simple section members subjected to basic loads
- Know how to model and analyze beams and simple structures

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Analysis of complex section members subjected to combined loads
- Use of three-dimensional failure criteria in prismatic members

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_3. An ability to communicate effectively with a range of audiences
- ABET_6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

BIBLIOGRAPHY

TEXT BOOKS

OTHER MATERIALS

http://rm.etsii.upm.es

55000022 – METALLIC MATERIALS SCIENCE

CREDITS:	4.5 ECTS
DEPARTMENT:	Applied Physics and Materials Engineering (P&M)
COURSE	Milagrosa González Fernández de Castro
COORDINATOR: TYPE:	Common
YEAR AND	3rd Year / Spring

LIST OF TOPICS

MODULE 1. INTRODUCTION TO PHYSICAL METALLURGY

- 1) General information about the subject
- 2) Metallic bond. Ideal crystals
- 3) Real crystals. Phases of metallic alloys
- 4) Diffusion. Phase transformations
- 5) Equilibrium diagrams
- 6) Solidification. Heterogeneities
- 7) Mechanical properties of metals

MODULE 2. FERROUS ALLOYS

- 8) Fe - Fe_3C diagram. Microconstituents of annealed steels
- 9) Austenite transformations. TTT and CCT diagrams
- 10) Heat treatments of steels. Quenching. Hardenability. Jominy test
- 11) Tempering. Annealings. Isothermal treatments
- 12) Thermochemical and surface treatments
- 13) Classification of steels. Steels for construction
- 14) Tool steels
- 15) Stainless steels
- 16) Diagram iron - graphite. Cast iron
- 17) Special cast iron

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC: Thermodynamics (55000013). General Physics II (55000006), Chemistry I (55000004)

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Management of software applications that allow the realization of simple technical calculations and AulaWeb

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Preselect the right alloy for a given application
- Suggest the most appropriate treatment for each application
- Read profitably on metallurgy technical literature so you can deepen the knowledge acquired in the course

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
- ABET_2. An ability to apply engineering design to produce solutions that meet specified needs with consideration fo public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
- ABET_5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
- ABET_6. An ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgment to draw conclusions

BIBLIOGRAPHY

TEXT BOOKS

Ingeniería y Ciencia de Materiales I
V. Blázquez; V. Lorenzo; B. del Río. Editorial Sección de Publicaciones de la ETSII, 2012

Ciencia e Ingeniería de Materiales (4ª Edición)
William F. Smith. Editorial McGraw Hill, 2006

Ciencia e Ingeniería de Materiales. Metalurgia Física
José Antonio Pero-Sanz Elorz Editorial Dossat, 1992

Ciencia e Ingeniería de Materiales
Donald R. Askeland. Editorial Paraninfo, 2001

Metalografía
A. P. Guliaev Editorial Mir, 1983

Metalografía de las Aleaciones Férreas
V. Blázquez Editorial Servicio de Publicaciones de la ETSII, 1991

OTHER MATERIALS

Power Point presentations of the course. Scripts of the course practices. Collection of last years' exams

55000024 - FLUID MECHANICS I

CREDITS:	4.5 ECTS
DEPARTMENT:	Energy Engineering (ENE)
COURSE COORDINATOR:	Jaime Carpio Huertas
TYPE:	Common
YEAR AND SEMESTER:	3rd Year / 1er semester

LIST OF TOPICS

MODULE 1. Fundamental

- 1) Macroscopic properties of fluids
- 2) Forces and tensions in a fluid: stress Tensor
- 3) Thermodynamics and transport phenomena

MODULE 2. Static fluid

- 4) Fluid in equilibrium
- 5) Forces on immersed surfaces
- 6) Surface of separation of two media: Surface Tension

MODULE 3. Kinematics

- 7) Kinematics of continuous media

MODULE 4. Integral extended to fluid volumes

- 8) Reynolds transport theorem in fluid volumes
- 9) Reynolds transport theorem in control volumes

MODULE 5. Conservation of mass

- 10) Mass conservation equation in integral form
- 11) Mass conservation equation in differential form

MODULE 6. Conservation of momentum

- 12) Momentum conservation equation in integral form
- 13) Force exerted by a fluid on the walls of a pipe
- 14) Force of a stream on a cascade of blades
- 15) Kinetic moment conservation equation in differential form
- 16) Momentum conservation equation in differential form
- 17) Navier Poisson's law
- 18) Navier Stokes equations
- 19) Mechanical Energy conservation equation in differential form.

MODULE 7. Conservation of energy

- 20) Energy conservation equation in differential form
- 21) Internal energy conservation equation in differential form
- 22) Entropy conservation equation in differential form
- 23) Energy conservation equation in integral form
- 24) Energy balance in a fluid machine
- 25) Equations of conservation for liquids
- 26) Energy balance in a hydraulic machine

RECOMMENDED COURSES OR KNOWLEDGE

RECOMMENDED PREVIOUS COURSES:

COURSE:

TOPIC:

RECOMMENDED PREVIOUS KNOWLEDGE OR ABILITIES:

- Basic knowledge of mechanics and thermodynamics
- Knowledge of algebra and calculus to mid-level.

SPECIFIC OUTCOMES FOR THE COURSE

At the end of the course, the student will be able to (or will have ability for):

- Ability to raise and solve problems of fluids in control volumes
- Knowledge of the fundamental equations of fluid mechanics

STUDENT OUTCOMES

- ABET_1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

BIBLIOGRAPHY

TEXT BOOKS

OTHER MATERIALS

1. Mecánica de Fluidos. Autor: Antonio Crespo. Ediciones Paraninfo (2010)

2. Colección de Problemas de Mecánica de Fluidos. Autores: Profesores de la asignatura. Sección de Publicaciones de la ETSII UPM (2011).

3. Problemas de Mecánica de Fluidos I (GITI). Autores: Profesores de la asignatura. Sección Publicaciones de la ETSII UPM (2018)